THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 12 Issue 8

RESEARCH ARTICLE

SARS2/COVID 19 in Middlesex County, Massachusetts: A Pilot Community Report

Ann A Kiessling[1]

[1]Bedford Research Foundation 124 South Road, Bedford, MA 01730, USA.

OPEN ACCESS

PUBLISHED
31 August 2024

CITATION
Kiessling, A., A., 2024. SARS2/ COVID 19 in Middlesex County, Massachusetts: A Pilot Community Report. Medical Research Archives, [online] 12(8). https://doi.org/10.18103/mra.v12i8.5613

DOI
https://doi.org/10.18103/mra.v12i8.5613

ISSN
2375-1924

ABSTRACT

The rapid spread, and relentless mutations of SARS2, are a reminder of how quickly upper respiratory viruses that do not cause acute, debilitating disease in all infected persons can spread, and that continuing mutation is an adaptive hallmark of viruses. The global response to the SARS2/COVID19 pandemic varied widely, country to country, and state to state in the United States of America (U.S.). To better prepare for the next pandemic, the U.S. Government Accounting Office recommends that health agencies "…identify, document and share all challenges and lessons learned … to improve the response to ongoing and future public health emergencies…" Some countries continually published SARS2/ COVID19 reviews and adjusted recommendations throughout the pandemic, but an objective review of the U.S. SARS2/COVID19 public health response is lacking. This knowledge gap can be at least partially filled by taking advantage of publicly-available databases. As an example, this is a report of the spread of SARS2/COVID19 in diverse communities in Middlesex County, Massachusetts. Neither mask mandates nor vaccinations halted the surge of SARS2/COVID19 in January, 2022; communities with the highest infection incidence were statistically significantly lowest in per capita income and highest in population density. If these findings apply globally, the development of a library of effective medications should be the first-line defense against the next pandemic, with a plan for effective distribution to the most vulnerable persons.

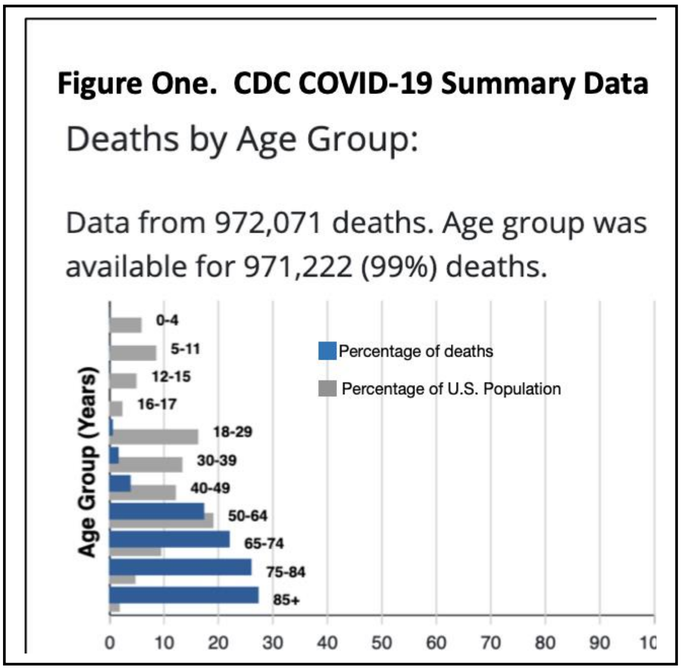
Introduction

Coronavirus disease 2019 (COVID19) taught the world how rapidly upper respiratory viruses spread, especially if they do not uniformly cause severe disease and death. Government response to outbreaks of Severe Acute Respiratory Syndrome 2 (SARS2), the coronavirus responsible for COVID19 pneumonia, varied widely from country to country. China locked down 57 million people around the city of Wuhan in early 2020[1] whereas other countries, such as Sweden took a more measured approach[2] and still other countries, such as Brazil, initially denied there was a major threat[3]. Previously, in 2017, based on decades of public health experience with influenza and other corona virus diseases, SARS and MERS, the United States of America (U.S.) Centers for Disease Control and Prevention (CDC) published detailed guidelines for public health response to a respiratory disease pandemic[4]. Surprisingly, U.S. federal and state governments did not refer local public health entities to those 2017 published guidelines at the outset of the pandemic, and instead recommended non-pharmaceutical interventions (NPIs) independent of those guidelines[4a]. The 2020 NPIs recommended by the CDC included six-foot distancing between persons plus masking everyone including children as young as two years old in all public places: retail establishments, gyms, barber shops, restaurants, schools, libraries, day care facilities, public transportation and health care facilities. Response to the recommended guidelines varied widely across the U.S., with some states and communities turning the recommendations into strict mandates throughout the pandemic, and other communities modifying mandates as new data emerged.

The cornerstone public health response for all disease outbreaks is "test and triage" to identify and isolate infected persons from the general population. In early 2020, the World Health Organization created a website repository for detailed information about the molecular tests for SARS2 being developed by countries all over the world, including the CDC. Due to testing capacity limitations, only severely ill people were tested in early 2020, leading to deaths from COVID19 estimated to be as high as 10% of infected persons, many-fold higher than influenza. This information marked the beginning of COVID19 hysteria as communal activities shut down all over the world.

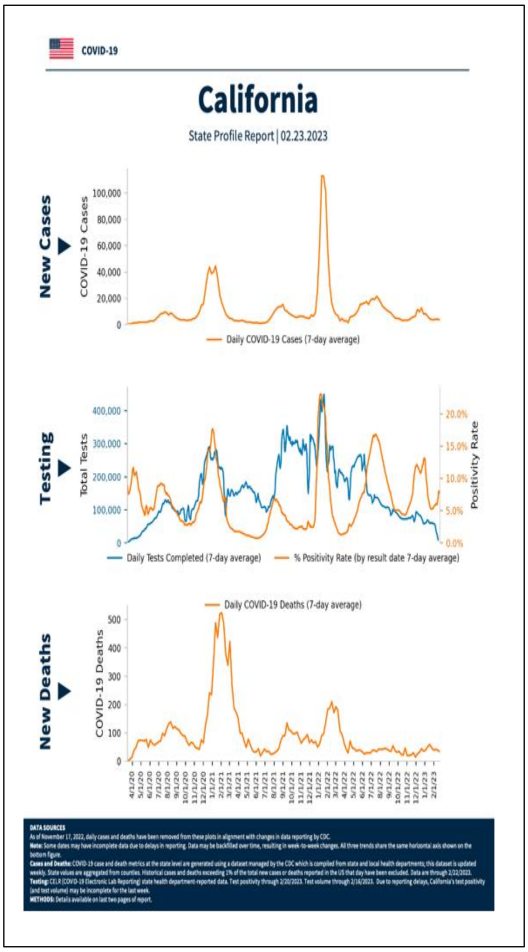
February 29, 2020, the U.S. Food and Drug Administration (FDA) encouraged federally licensed laboratories to develop a molecular (PCR-based) test for SARS2 in nasal secretions[5]. This FDA email heralded the federal government's acknowledgement that COVID19 was spreading rapidly within the U.S, and that the CDC lacked sufficient laboratory testing capacity in each state to adequately triage infected patients within the health care system and long-term care facilities. Dozens of independent, federally licensed U.S. laboratories rapidly developed tests for SARS2.

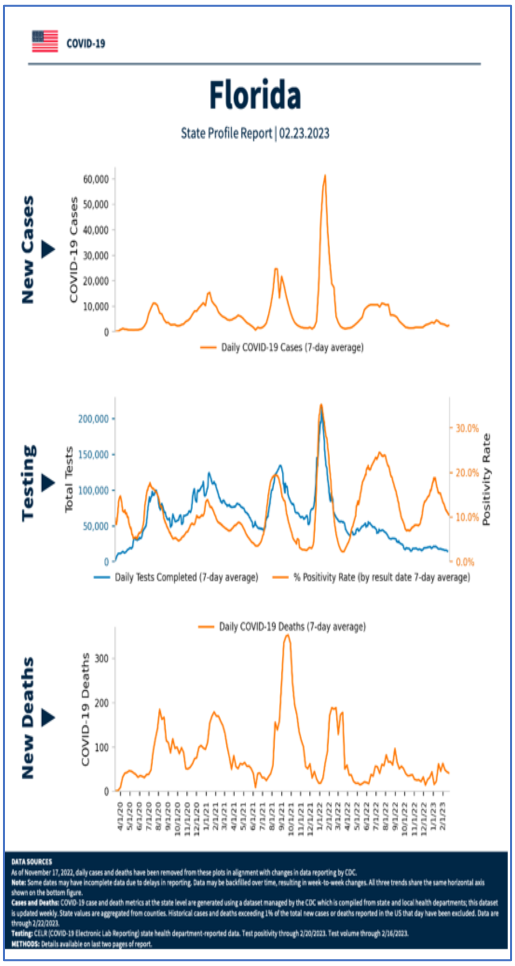
Once testing capacity met the demand by summer, 2020, it became clear that the death rate was orders of magnitude lower than original estimates and essentially limited to the very old — at least half of healthy persons under the age of 50 had no disease symptoms when they tested positive for SARS2. This trend continued throughout the pandemic in the U.S., as summarized by the CDC in early 2023 (Figure 1). These characteristics prompted scholars from Stanford, Harvard and Oxford Universities to promote pandemic guidance in late 2020 that protected the vulnerable and the elderly and reopened schools and businesses and the rest of society, similar to the 2017 CDC strategies[6]. This academic guidance was not only ignored, it was loudly rejected by U. S. government officials providing guidance to the states[7-9].



Efforts to combat the initial COVID19 hysteria in the U.S. varied widely. Some states, such as California, kept strict mandates in place[10]; other states, such as Florida with 60% of the population of CA, implemented strategies similar to Sweden and the CDC 2017 guidelines, i.e. protect the elderly, and allow other lockdowns to be lifted[11]. The CDC's summary of cases, testing, and deaths for those two states from early 2020 to early 2023 reveal similar COVID19 outcomes (Figure 2), supporting the difficulty inherent in predicting and restricting the spread of respiratory viruses.

Figure 2. CDC State COVID-19 Profiles, April, 2020 through February, 2023





The variance between government policies and accumulating data about SARS2/COVID19 risks has resulted in wide-spread confusion around government dictates not in keeping with accumulating data, including statements that mass vaccination programs would prevent virus spread[12-14]. Such global public skepticism will thwart appreciation for and adherence to public health guidance during the next pandemic.

The U. S. Government Accounting Office (GAO) reviewed COVID19 actions of Health and Human Services (HHS, the U. S. agency that oversees the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA)), and reported in Nov, 2023:

> "As of March 2022, after more than 2 years of experience in responding to the COVID-19 pandemic, HHS had not taken steps to identify, document, and share all challenges and lessons learned that public health entities experienced during the pandemic—information it could incorporate in its planning and implementation of the public health situational awareness and biosurveillance network. Until HHS takes these steps, opportunities to improve the response to ongoing and future public health emergencies by learning from past challenges will likely be missed."

This admonition[15] from the U.S. GAO encourages all health agencies to review their COVID19 response to "…identify, document, and share all challenges and lessons learned…" in order to be better prepared for the next pandemic. A way forward is to publicly report what did, and did not, benefit overall public health in the face of the SARS2/COVID19 pandemic. This will best be accomplished at the grass-roots community level rather than by agency modeling.

The Commonwealth of Massachusetts has more independent Boards of Health (351) than any other state in the U.S.[16] because Commonwealth statute directs every municipality to elect a Board of Health, charged with overseeing local public health issues and developing appropriate community policies in response, while implementing state and federal health guidelines, including COVID19 recommendations. To prepare for the next pandemic, it is imperative that each and every community evaluate its local COVID19 response with respect to impact on day care facilities, education, businesses, long term care facilities, overall health of the public and COVID19 hospitalizations and deaths. Community engagement and education is a pillar of successful public health response, as noted in the CDC 2017 guidelines, and community cooperation will be essential during the next pandemic.

Middlesex County, Massachusetts, is a highly diverse county with a total population of 1,615,000 persons, average per capita income of $83,492 and average population density of 3,278 persons per sq mile[17] (Table 1). It has 54 cities and towns, many of which were formed before the 1776 American Revolutionary War began in Lexington and Concord to overturn monarchy rule. Cambridge is home to Harvard University, Massachusetts Institute of Technology, the Broad Institute and Moderna, one of the COVID19 mRNA vaccine manufacturers. Each of the 54 communities is self-governed, with its own Board of Health, School Committee, and governing body of either a volunteer Select Board of three to five elected officials, with most town decisions made by all citizens, or representatives, at a Town Meeting, or by a Mayor with a Town Council. "Home Rule" is an over-arching principle in Massachusetts, a hold-over from over-turning monarchy rule, that defers many governance decisions to each community which represent a wide cross-section of society: rural communities and large cities, poor communities and wealthy communities, sprawling communities and densely populated communities (Table 1, Table 1S).

In March, 2020, Massachusetts was one of the first U. S. states to experience an outbreak of SARS2 infections partly because of an international conference of a biomedical research company held in a downtown Boston hotel[18]. Conference attendees were from Europe and China as well as the U.S. The lack of tests for SARS2/COVID19 heralded the confusion and panic that immediately followed. The CDC had limited capacity to support the testing needs of MA physicians noticing lung diseases in keeping with characteristics reported for COVID19. A physician in western MA had to requests SARS2 tests through the MA Department of Public Health multiple times before permission to forward them to the CDC was granted[18]. Intervening in physicians' care for their patients became wide-spread in the U.S. during the COVID19 emergency era.

To begin to more fully understand the impact of community circumstances and government public health responses on the spread of SARS2/COVID19 in Middlesex County, as a pilot project for the rest of the state and the U.S, a data set from the MA Department of Public Health and the MA Division of Local Services has been compiled that encompasses the time frame from June, 2021, through January, 2022. The analyses of this data set reported herein reveals the statistically most significant societal circumstances involved in SARS2 spread with respect to population density, income per capita, mask mandates and percentage of community residents vaccinated. Neither mask mandates nor vaccinations stopped the spread of SARS2 in Middlesex County.

Methods and Materials

The MA Division of Local Services maintains a public database of average income per capita and population density of every state community[17]. On Dec 21, 2021, the Boston Globe published an interactive map on mask mandates imposed by Boards of Health in each Massachusetts Community[19]. The MA Department of Public Health (MADPH) posted tables of COVID19 test results for each Middlesex County community[20]. The time period of July, 2021, through January, 2022, was chosen as a unique data set of testing results because home test kits were not yet readily available, so testing was being conducted and reported to the MADPH by licensed laboratories. This time interval also spans a massive roll-out of vaccination clinics in MA, a dramatic dip in positive SARS2 tests in June, 2021, followed by the equally massive surge in positive cases that occurred in January, 2022. By February, 2022, at home test kits were widely available and licensed laboratories were no longer solely responsible for the PCR tests being reported to the MA Dept of Public Health, so testing data are no longer accurate.

The Executive Branch of the MA government interpreted federal guidance issued routinely throughout the pandemic and announced COVID19 Emergency Response guidelines that were to be enforced by local communities. In early 2020, school and business lockdowns and the size of community gatherings were mandated. By the fall of 2020, most state-wide mandates had reverted to recommendations, such as wearing masks in public places, which were then interpreted by individual communities.

Five metrics were downloaded from the public datasets and are included for the seven month time period chosen for this pilot study: population density and income per capita, communities with mask mandates, percentage of the community vaccinated, and positive SARS2 tests per 100,000 population reported by the MADPH as a rolling average for every two week interval. Data are included herein as an Excel spreadsheet for each two week average (Table S1) and as a monthly truncated version for discussion purposes (Table 1).

The data sets were analyzed by Student's T Test and ANOVA) (PRISM and Numbers) with p values less than 0.02 taken as statistically significant.

Results

MASK MANDATES

Twenty three (43%) of the 54 communities had no mask mandate, only a "mask recommendation in public places" from the MA Governor's Covid Task Force, 16 (30%) had mask mandates in municipal buildings only, and 15 (28%) had mask mandates in all public spaces (Table 1, Table 1S). The averages of the incidence of positive SARS2 tests per 100,000 population were not statistically significantly different for mask-mandated communities from no mask-mandated communities (Figure 3).

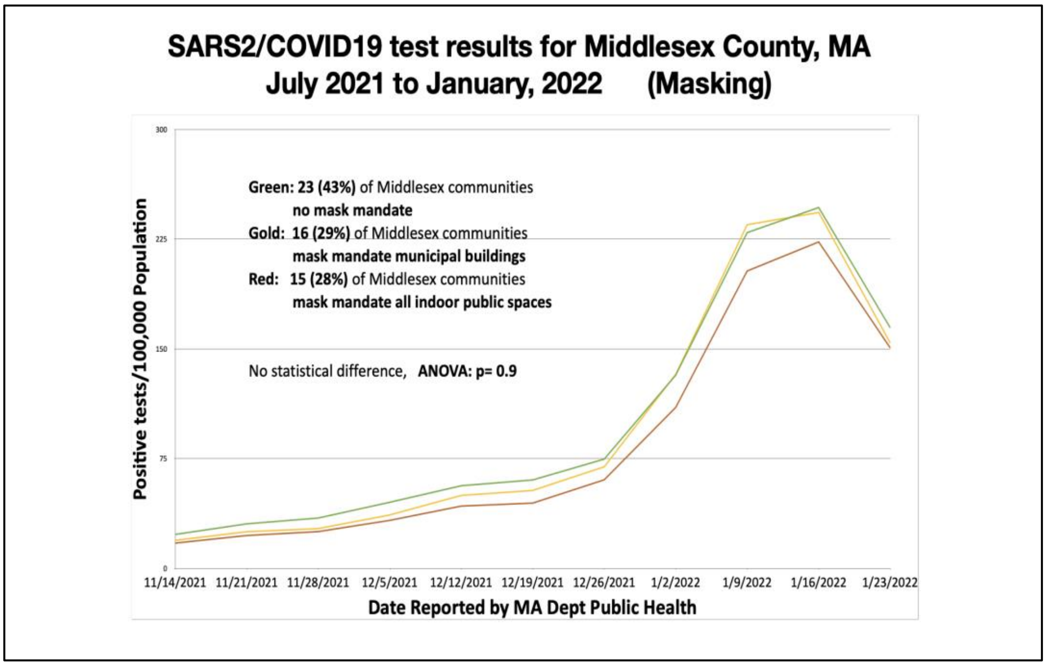
Table 1. Community Data, Middlesex County, Massachusetts, July, 2021-January, 2022

CITY/TOWN	Mask Mandates	2021 Population	Population Density	2020 Income Per Capita	• 7/4/21 - 7/17/21	8/1/21 - 8/14/21	9/5/21 - 9/18/21	10/3/21 - 10/16/21	11/7/21 - 11/20/21	12/5/21 - 12/18/21	1/2/22 - 1/15/22	1/9/22 - 1/22/22	% Fully Vaccinated Jan, 2022
Acton	0	23,846	1,200	81,081	1.8	6.6	7.8	6.3	22.3	30.1	175.5	121.6	95.8
Ashby	0	3,170	134	38,719	4.1	12.3	36.9	32.8	30.7	88.1	131.1	135.2	71.6
Ashland	0	18,560	1,505	59,335	0.4	13.4	10.5	5.8	19.6	47.5	230.6	148.7	94.9
Ayer	0	8,400	942	40,320	1.8	7.9	18.5	23.8	50.3	68.8	289.3	226.7	87.8
Boxborough	0	5,425	527	73,599	0.0	4.2	35.2	15.5	15.5	39.4	188.7	102.8	92.2
Burlington	0	25,989	2,216	59,089	3.9	10.5	11.6	12.8	28.5	58.3	249.3	158.4	91.1
Chelmsford	0	35,933	1,606	61,805	2.2	10.3	29.4	18.9	38.5	48.6	222.4	152.3	87.4
Concord	0	18,184	742	166,197	1.1	14.9	11.8	11.1	14.9	30.9	170.8	114.4	99.8
Dracut	0	32,159	1,559	39,887	1.5	24.0	26.0	30.4	58.4	103.8	287.8	188.0	75.7
Everett	0	48,557	14,157	24,363	1.3	13.5	22.8	15.7	21.3	57.7	467.4	243.5	84.4
Hopkinton	0	18,943	721	94,319	0.9	17.0	14.8	20.1	26.6	74.6	284.7	174.8	91.7
Marlborough	0	41,110	1,970	40,015	0.7	11.8	15.1	17.2	32.1	57.3	410.1	250.9	88.6
Pepperell	0	11,577	512	45,071	1.2	25.0	19.2	22.7	30.2	69.1	141.8	118.0	76.5
Reading	0	25,223	2,535	73,100	0.8	9.3	18.6	15.5	30.7	55.2	220.4	141.9	91.4
Shirley	0	7,279	459	35,497	0.8	56.1	15.9	15.1	22.6	44.4	232.1	202.7	74.3
Stoneham	0	22,877	3,800	52,421	3.5	26.9	14.4	28.6	29.8	67.7	283.3	192.5	88.1
Stow	0	7,059	408	83,990	2.0	13.8	17.7	12.8	13.8	40.4	213.0	154.8	93.3
Tewksbury	0	30,876	1,492	47,985	3.0	11.8	23.6	23.4	33.6	86.7	296.6	193.9	81.4
Townsend	0	8,983	274	40,552	0.8	17.2	18.8	32.9	54.1	70.5	146.6	110.5	74.7
Tyngsborough	0	12,421	741	49,058	0.6	11.3	38.2	20.9	51.9	93.0	236.1	170.5	76.7
Waltham	0	64,015	5,029	43,501	4.9	12.3	20.0	11.6	20.2	53.4	228.2	139.2	83.6
Watertown	0	35,149	8,809	54,414	2.8	11.7	8.6	13.4	21.6	42.2	212.8	136.6	89.2
Woburn	0	41,056	3,248	49,289	1.9	15.5	21.3	13.2	31.7	61.4	354.9	205.4	84.3
Average		23,774	2,373	58,852	1.8	15.5	19.9	18.3	30.4	60.4	246.7	164.5	85.8
	All Public												
Arlington	1	45,617	8,858	74,842	2.2	10.3	11.5	6.4	12.5	29.1	140.9	92.0	93.4
Bedford	1	14,155	1,036	82,483	3.3	9.1	23.8	11.9	18.6	39.1	296.8	188.6	91.2
Belmont	1	26,838	5,772	116,207	2.1	10.7	9.6	8.3	14.3	30.5	197.5	130.6	94.7
Billerica	1	41,453	1,621	46,050	2.5	12.8	27.2	22.2	36.3	78.3	252.2	171.6	82.8
Cambridge	1	117,090	18,324	74,061	3.1	11.2	17.5	7.7	17.5	57.7	278.1	190.3	86.1
Carlisle	1	5,181	340	229,125	1.5	6.0	9.1	15.1	13.6	31.8	288.9	186.0	95.9
Dunstable	1	3,341	203	78,539	4.3	12.9	23.6	12.9	36.5	51.5	145.8	103.0	77.9
Lexington	1	34,071	2,074	139,581	1.0	10.3	8.0	8.2	10.3	26.6	186.1	139.0	101.0
Lincoln	1	6,890	484	160,933	1.6	9.0	2.5	4.9	2.5	9.0	126.5	87.1	91.9
Littleton	1	10,121	613	64,359	0.7	10.2	19.8	38.1	46.1	49.8	234.3	160.3	92.1
Lowell	1	113,994	8,394	25,563	2.5	19.6	21.8	18.0	47.3	86.2	351.4	232.2	75.0
Newton	1	87,453	4,902	163,628	2.5	9.0	13.6	15.9	11.9	35.8	172.0	134.6	104.5
Somerville	1	79,815	19,373	52,596	2.8	12.6	19.0	12.0	20.3	54.0	241.2	155.4	87.4
Sudbury	1	19,059	785	120,396	2.0	8.4	11.2	13.2	13.2	40.5	204.9	137.6	93.3
Westford	1	24,446	808	72,500	3.7	6.2	15.2	21.0	35.3	48.6	230.5	152.5	92.0
Average		41,968	4,906	100,058	2.4	10.6	15.5	14.4	22.4	44.6	223.1	150.7	90.6
	Mun Bldg												
Framingham	2	71,265	2,846	41,182	1.5	12.3	10.4	10.1	20.0	63.6	340.4	227.0	92.3
Groton	2	11,147	340	86,514	3.1	12.2	12.8	14.1	20.8	55.0	175.4	110.6	91.1
Holliston	2	14,840	796	65,547	1.0	18.7	15.1	17.2	19.8	45.3	221.7	161.3	92.7
Hudson	2	19,790	1,718	44,478	3.1	10.5	18.3	16.6	22.7	57.0	360.9	203.2	89.7
Malden	2	65,074	12,912	32,422	1.9	15.0	15.2	11.9	21.6	52.5	323.8	184.0	88.9
Maynard	2	10,574	2,030	46,985	2.1	6.9	17.8	13.7	37.1	35.0	214.2	153.1	90.1
Medford	2	62,098	7,666	44,898	3.4	12.5	22.7	14.1	27.9	58.4	292.1	190.6	84.4
Melrose	2	29,312	6,263	60,541	2.2	14.3	15.0	14.3	26.4	64.1	255.3	165.6	89.8
Natick	2	36,426	2,437	69,429	3.2	9.5	12.9	8.9	13.1	35.3	219.3	131.9	94.4
North Reading	2	15,343	1,168	72,066	1.3	16.3	21.4	13.7	24.9	97.3	236.3	153.1	88.4
Sherborn	2	4,390	277	236,034	1.9	17.0	18.9	13.3	20.8	51.1	215.8	128.7	94.6
Wakefield	2	27,104	3,683	55,294	1.6	12.4	22.4	18.4	35.3	63.0	239.7	155.4	85.5
Wayland	2	13,724	912	177,727	0.5	18.9	9.7	9.7	30.3	35.7	201.0	144.3	100.5
Weston	2	11,666	694	430,522	2.0	17.6	16.3	14.3	9.1	31.2	184.1	122.9	93.5
Wilmington	2	23,012	1,355	53,566	2.3	10.2	19.3	19.0	35.0	78.8	251.1	151.6	84.9
Average		27,718	3,006	101,147	2.1	13.6	16.6	14.0	24.3	54.9	248.7	158.9	90.7

•Two week rolling average of PCR pos SARS2 tests per 100,000 population

The average income per capita for the communities without a mask mandate ($58,852) was statistically significantly lower ($p=<0.02$) than the average income per capita of communities with mask mandates: $100,058, masks mandated all public spaces, $101,147, masks mandated in municipal buildings only (Table 1). The three forms of government (Open Town Meeting, Representative Town Meeting, or Mayor with Council) were equally represented in all three masking groups.

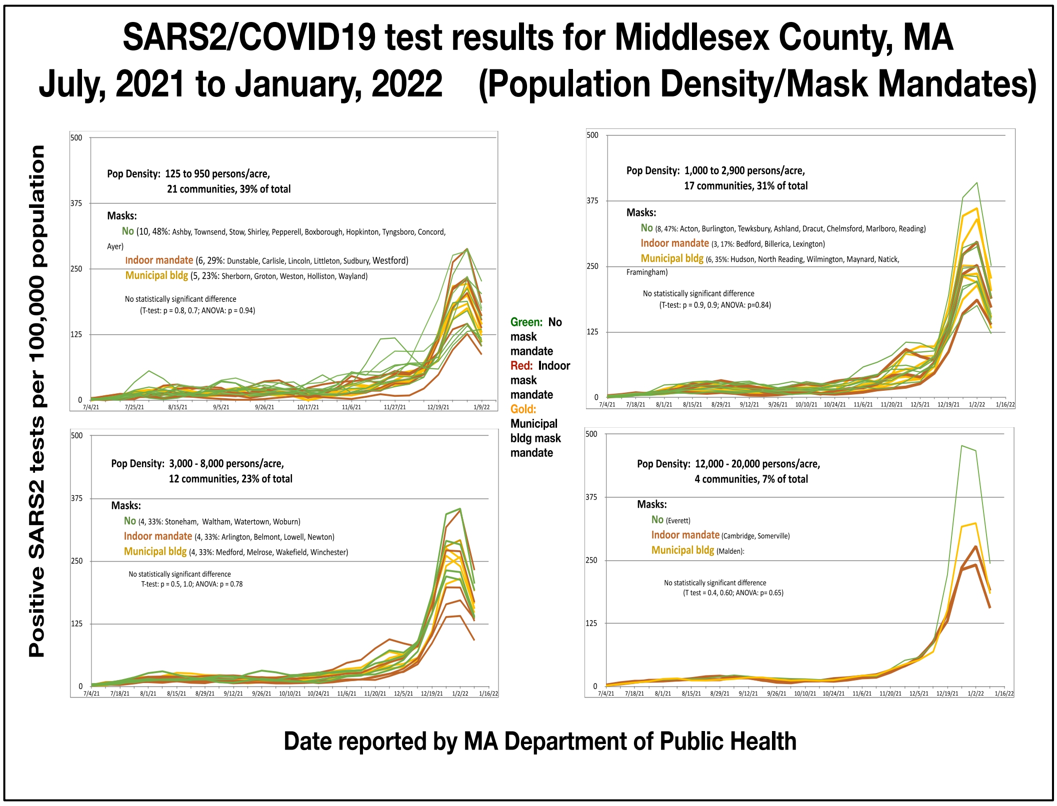
Figure 3. Average SARS2 Positive tests per 100,000 population/mask mandates



POPULATION DENSITY

Twentytwo communities have population densities fewer than 1,000 persons per acre, 17 communities have population densities between 1,000 and 3,000 persons per acre, 12 communities have population densities between 3,000 and 12,000 persons per acre and four communities have population densities above 12,000 persons per acre (Cambridge, Somerville, Malden and Everett). SARS2 positive tests per 100,000 population were not significantly different between population densities from 1000 persons per acre, to 20,000 persons per acre (Table 1, Figure 4). Within each population group, there were no statistically significantly different infection incidences among mask-mandated versus mask-recommended communities (Figure 4). The 1.7-fold increase in the no mask-mandate, highest population community was not statistically significant because the over-all rise in infections was 50-fold (Figure 4).

Figure 4. Average SARS2 Positive tests per 100,000 population/population density/masks



INCOME PER CAPITA

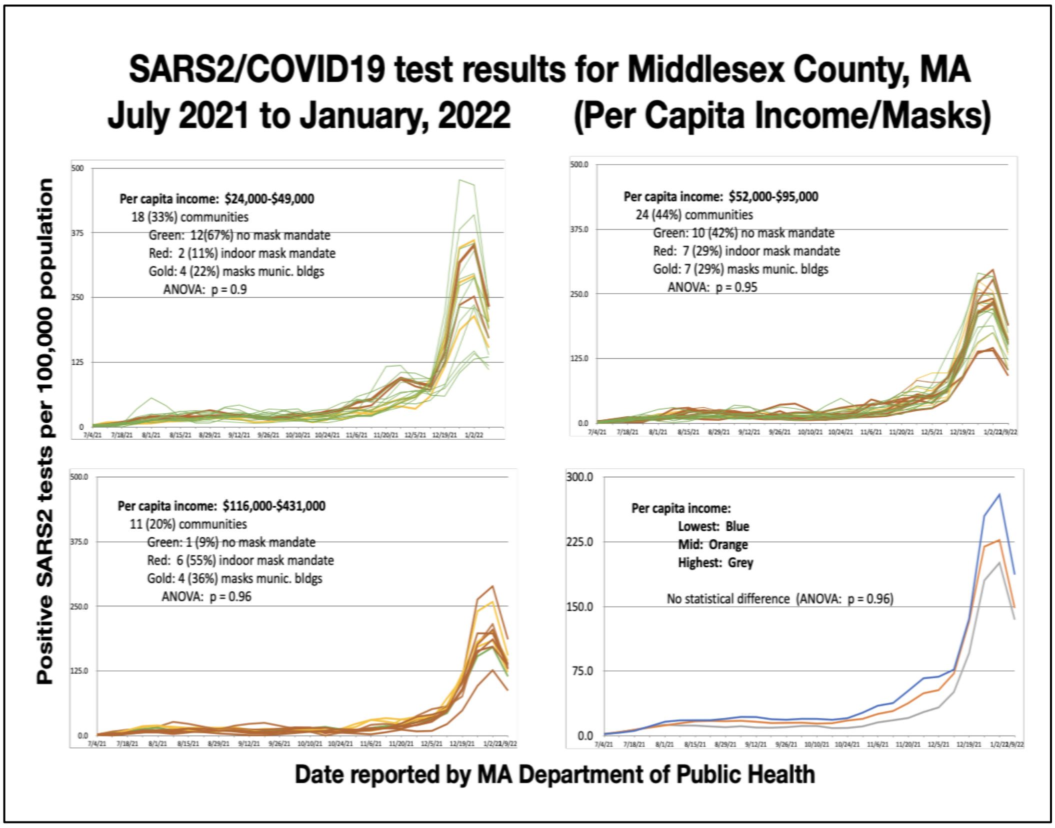
Twenty communities have annual income per capita between $25,000 and $50,000, twenty-four communities have annual income per capita between $50,000 and $100,000, eleven communities have annual per capita income between $100,000 and $500,000 (Table 1). SARS2 positive tests did not differ statistically significantly relative to income level; within each income group, there was no statistically different infection incidence among masked versus unmasked communities (Figure 5). Although the infection incidence in the lowest income group was 1.4-fold greater than the highest income group, this difference was not significant because the over-all increase in infections was on the order of 50-fold at the peak of the January, 2022, surge (Table 1, Figure 5).

SARS2 VACCINATION EFFICACY

The effect of vaccination on SARS2 transmission was evaluated in two different ways: (1) positive tests/100,000 population in the peak of disease in Jan, 2021, before wide-spread vaccination, compared with positive tests per 100,000 population in the peak of disease transmission in Jan, 2022, when over 90% of MA residents had received at least one SARS2 vaccination, according to the MADPH[20], and (2) comparing vaccination percentages in communities with differing incidences of infections during the Jan, 2022, surge.

First, in Jan, 2021, wide spread SARS2 testing was available throughout Middlesex County; 5.5% of SARS2 tests were positive, 59.4 per 100,000 population[20]. In Jan, 2022, 15.3% of SARS2 tests were positive, average of 241.2/100,000 population, a four-fold increase in incidence of infection with the majority of residents vaccinated (Table 1)[20].

Figure 5. Average SARS2 Positive tests per 100,000 population/income/masks



Second, 14 Middlesex County communities had 100 to 200 infections per 100,000 population in Jan, 2022, mean 163 with 89.9% of their population fully vaccinated (Table 1); 32 communities had 200 to 300 infections per 100,000 population in Jan, 2022, mean 246 with 88.5% of their population fully vaccinated, and seven communities had 300 to 500 infections per 100,000 with 86.2% of their population fully vaccinated. Although there is a statistically significant difference in infection incidence between the lower infection group of 14 communities, and the higher infection group of seven communities, there is no difference in percent of population vaccinated in those two groups. Neither group was statistically significantly different from the mid-infection group of 200 to 300 infections per 100,000 population. In agreement with other assessments of the absence of effect of mask mandates on infection incidence[21,22], six (43%) of the 14 lowest infection communities and three (43%) of the seven highest infection communities had no mask mandates.

INFECTION INCIDENCE

Although comparing SARS2 infections in communities by income per capita and population density revealed no statistically different incidence of infection between those groups during the seven months included in this report, those indices did differ with infection incidence in January, 2022. The population density (average of 1,908 persons per sq acre) in the 14 communities with the lowest infection incidence is statistically significantly ($p<0.02$) lower than the population density in the seven communities with the highest infection incidence (6,464 persons per sq acre). The income per capita distribution in the highest infection incidence group (average of \$36,759) is also statistically significantly ($p<0.02$) lower than the income per capita in the lowest infection group (average of \$121,142). These indices were not, however, statistically significantly different from the mid-infection group of 32 communities.

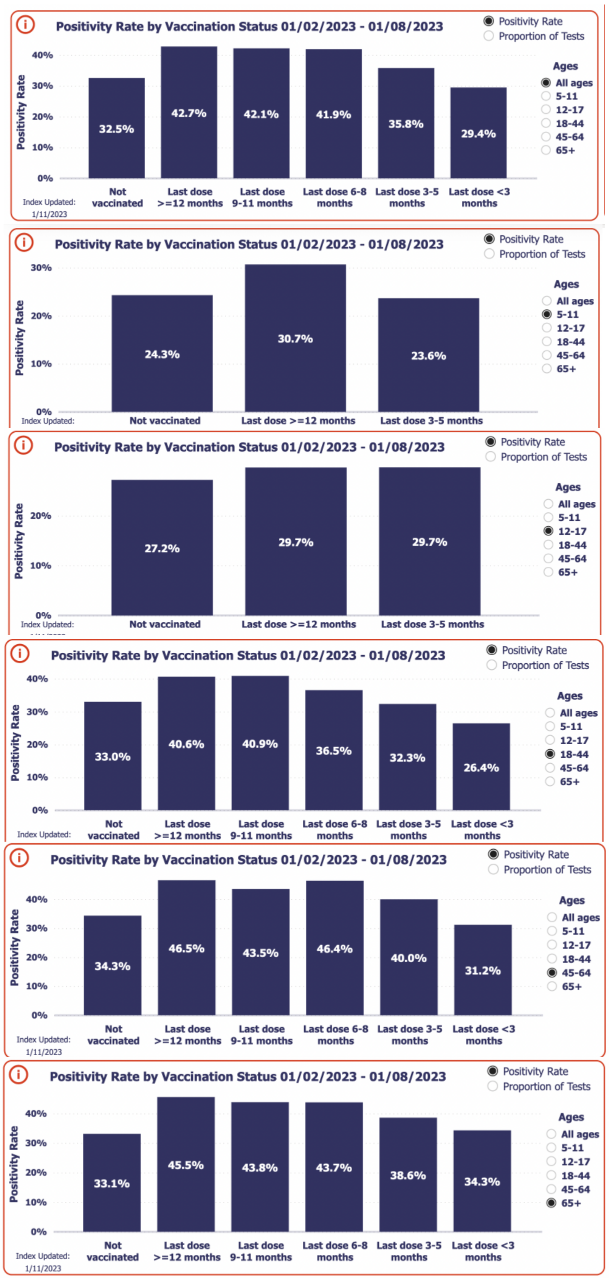
Discussion

In keeping with other reviews of the efficacy of public mask mandates to stop the spread of respiratory viruses, none of the comparisons in this report detected any statistically significant benefit to mask mandates in halting the spread of SARS2. This is also in agreement with the CDC guidelines of 2017 that point out the value of masking persons known to be infected, in keeping with decades of public health experience with the spread of respiratory viruses, but questionable value in masking the general public. At this time, it remains unclear why the recommendation was made by the CDC to mask children as young as two years old, the World Health Organization guideline was for five year olds only IF they were in crowded conditions. Studies are notably lacking that placing masks on young faces has any effect on respiratory virus spread, but many studies have appeared that masking young children is detrimental, especially to speech development[23]. How the U.S. CDC arrived at this recommendation for small children is urgently needed information.

The issue of mask mandates is peripheral to the efficacy of masks themselves which has become a widely debated topic. Mandates require enforcement which becomes highly problematic, especially in small communities, and may suggest more efficacy in stopping virus spread than actually exists. It is helpful to mask infected persons, it is not helpful to suggest to highly vulnerable persons that a mask will protect them from infection by a respiratory virus. Research with respiratory viruses is conducted in specially designed containment facilities with unique air-handling systems, not by scientists simply wearing masks in an open laboratory setting. Although probably not zero, the efficacy of masking the general public to prevent spread of respiratory viruses may be on the order of 9%, as reported in the large Bangladesh study[24], and this might be due to randomly masking asymptomatic, infected individuals. The community benefits of masks are far lower than the community benefits of routine testing to identify contagious individuals.

It has been known for decades that annual influenza vaccinations do little to stop the spread of influenza virus; the efficacy of the annual influenza vaccine is judged by estimates of reduction of doctor visits and hospitalizations due to influenza diseases[25]. All the vaccines developed against SARS2 seem to have a similar characteristic, a possible decrease in severe disease but little if any decrease in disease transmission. The data analyzed herein are supported by other lines of evidence, including a report on SARS2 transmission in the prison population in Connecticut[26], and data maintained by the Walgreen pharmacies once they began both testing for SARS and administering vaccines. The CT prison study concluded that vaccination and/or history of SARS2 infection, or both, had some infection prevention at the level of outbreaks in the prison overall, and/or specific cell blocks, but not against an infected cell mate. The study was conducted during the time masking was mandated in public facilities throughout CT, but adherence to the mask directive was not included in the report.

Figure 6. Positive SARS2 by age



An example of one week of data collection by Walgreens, Figure 6, illustrates the absence of an effect of vaccination against a new infection.

These data do not devalue the efficacy of virus-specific vaccines to alleviate over-all public health, but they do emphasize that massive vaccination programs should not be expected to stop the spread of a respiratory virus.

The over-arching message from the Middlesex County communities data set is the advantage that members of low population density, high income communities have against infection by a respiratory virus. In the context of population density and income, neither vaccination status nor mask mandates provided additional protection. This observation agrees with the data from the CT prison system that vaccination status (and perhaps masking) did not overcome proximity of exposure to an infected person.

If these observations are borne out by larger studies in other communities, public health preparedness against the next pandemic needs to start with a list of anti-viral medications known to reduce viral burden within days, followed by a detailed plan to dispense those medications to high population density, low income communities. As candidate viruses emerge, such as the current bird flu (H5N1), efforts should be underway to assure wide-spread, ample testing capacity and to develop a library of anti-viral pharmaceuticals effective in multiple species. The value of this approach has been proven by the two recent pandemics, HIV/AIDS and Hepatitis C. Treatments for HIV infection were initially delayed pending vaccine development, but once federal funding was available, HIV has been successfully treated for three decades by two dozen new anti-viral medications that were developed very rapidly through collaborations between NIH-funded basic scientists and pharmaceutical companies. Although dozens of HIV-vaccines have undergone clinical trials, none have been successful, in keeping with the lack of effective vaccines against other sexually transmitted diseases such as syphilis and gonorrhea, both of which can re-infect an individual with high titers of circulating antibodies. Hepatitis C is now curable with a combination of a specific anti-viral medication and an interferon augmentation of immune response.

Viruses have several replication pathways in common with each other since they all must utilize a strategy to hijack the host cell's nucleic acid and protein duplication machinery after gaining entry. Although a legacy HIV medication, ritonavir, was known to also be effective against SARS2 as early as 2020[28], that information was not widely disseminated until later in the pandemic. It is not too early to start developing medications effective against avian flu virus so they are "off the shelf" in emergency rooms all over the world should a human outbreak occur. Vaccines are a powerful tool against many pathogens, but they are not an effective tool against a new outbreak of a respiratory virus, as the world has now learned.

As this report was being developed, Dr. Robert Redfield, former director of the U.S. CDC, testified before a Senate subcommittee that pharmaceutical development against avian flu should be considered more important than vaccine development.[29] In addition, two more COVID19 reviews were reported, one from a Canadian statistics research group[30] and one from the United Kingdom[31], both highlighting the importance of every community reviewing it's response to the SARS2 pandemic to better prepare for the next one.

Conclusions

Considering the major societal disruptions brought on by government mandates responding to the COVID19 pandemic, all communities owe their residents an objective review of the value of each mandate imposed in preventing COVID19 severe disease and deaths. Although they are important treatments to alleviate severity of disease in vulnerable populations, anti-SARS2 vaccines, like influenza vaccines, do not stop the spread of infections. As has been amply demonstrated for HIV and Hepatitis C, drugs that inhibit specific virus replication pathways are highly effective in reducing virus spread by infected individuals. Therefore, as public health epidemiologists identify emerging pathogen threats, scientific efforts should be immediately launched to screen existing medications for efficacy against the new disease threats and/or develop appropriate and effective new medications if none exist. SARS2/COVID19 proved to the world the negative toll that societal lock-downs while awaiting vaccine development can have on over-all health and well-being, especially to the world's children.

Conflict of Interest:

None

Funding Statement:

None.

Acknowledgements:

Data interns Caroline Liu and Matthew Sullivan downloaded and linked the relevant data for municipalities in Middlesex County from Massachusetts.gov public websites. AK analyzed the data and prepared the manuscript. AK and CL were funded by Bedford Research Foundation; MS was funded by Mass Life Sciences Center.

References:

1. Wu S, Yao M, Deng C, et al. Social Isolation and Anxiety Disorder During the COVID-19 Pandemic and Lockdown in China. *J Affect Disord.* Nov 1 2021;294:10-16. doi: 10.1016/j.jad.2021.06.067.

2. Norberg, Johan. "Sweden during the Pandemic: Pariah or Paragon?," Policy Analysis no. 959, CATO Institute, August 29, 2023.

3. Sott M , Bender M, Baum K. Covid-19 outbreak in Brazil: health, social, political and economic implications. *Int'l J of Health Services.* 2022; (52)4: 1-13. DOI: 10.1177/00207314221122658.

4. Qualls N, Levitt A, Kanade N, et al. CDC Community Mitigation Guidelines Work Group. Community Mitigation Guidelines to Prevent Pandemic Influenza – United States. *MMWR Recomm Rep.* 2017 Apr 21;66(1):1-34. doi: 10.15585/mmwr.rr6601a1.

4a. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. https://www.cdc.gov/coronavirus/2019-ncov/covid-19-data-and-surveillance.html

5. Shuren, J. Coronavirus (COVID-19) Update: FDA issues new policy to help expedite availability of diagnostics. Feb 29, 2020. https://wayback.archive-it.org/7993/20201217234232/https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-issues-new-policy-help-expedite-availability-diagnostics

6. Kulldorff M, Gupta S, Battacharya J. *Great Barrington Declaration, Focused Protection.* Oct 4, 2020. https://gbdeclaration.org/.

7. Editorial Board. How Fauci and Collins shut down COVID debate. *Wall Street Journal,* Dec 21, 2021. https://www.wsj.com/articles/fauci-collins-emails-great-barrington-declaration-covid-pandemic-lockdown-11640129116

8. Prasad V. At a time when the U.S. needed COVID-19 dialogue between scientist, Francis Collins moved to shut it down. *STAT* Dec 29, 2022 https://www.statnews.com/2021/12/23/at-a-time-when-the-u-s-needed-covid-19-dialogue-between-scientists-francis-collins-moved-to-shut-it-down/

9. ABC News. Fauci calls 'herd immunity' declaration embraced by White House 'ridiculous." Oct 15, 2020. https://abcnews.go.com/Health/live-updates/coronavirus/fauci-calls-herd-immunity-declaration-embraced-by-white-house-ridiculous-73627869?id=73623859

10. California Department of Public Health. https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/COVID-19-Isolation-Guidance.aspx.

11. Florida Department of Public Health. https://www.floridahealth.gov/diseases-and-conditions/respiratory-illness/COVID-19/index.html

12. Wake AD. The Willingness to Receive COVID-19 Vaccine and Its Associated Factors: "Vaccination Refusal Could Prolong the War of This Pandemic" - A Systematic Review. *Risk Manag Health Policy.* 2021 Jun 21;14:2609-2623. doi: 10.2147/RMHP.S311074.

13. Osamor VC, Ikeakanam E, Bishung JU, et al. COVID-19 Vaccines: Computational tools and Development. *Inform Med Unlocked.* 2023;37:101164. doi: 10.1016/j.imu.2023.101164.

14. Choi J. Fauci: Vaccinated people become 'dead ends' for the coronavirus. *The Hill* May 16, 2021. https://thehill.com/homenews/sunday-talk-shows/553773-fauci-vaccinated-people-become-dead-ends-for-the-coronavirus/.

15. United States Government Accountability Office. COVID-19: GAO recommendations can help federal agencies better prepare for future public health emergencies. *GAO COVID19 Eval,* July, 2023: GAO -23- 106554. https://www.gao.gov/coronavirus

16. Mauzy S, Putney K, Baroni E, et al. Lessons Learned: The Varied Responses of Massachusetts' Local Health Departments During the COVID-19 Pandemic. *J Public Health Manag Pract.* 2022 Jul-

Aug 01;28(4):344-352. doi: 10.1097/PHH.0000000000001547.

17. Division of Local Services, *MA Department of Revenue*, 2024 posting. https://dlsgateway.dor.state.ma.us/reports/rdPage.aspx?rdReport=Community_Comparison_Report

18. Allen E, Hohler B and Swidey N. The virus's tale. *Boston Globe* May 30, 2020. https://apps.bostonglobe.com/metro/graphics/2020/05/coronavirus-tale/

19. Fatima S. These are all the Massachusetts towns that have indoor mask mandates. *The Boston Globe*, December 14, 2021. https://www.bostonglobe.com/2021/12/15/nation/these-are-all-massachusetts-towns-that-have-indoor-mask-mandates/

20. Massachusetts Department of Public Health Coronavirus Disease 2019. https://www.mass.gov/coronavirus-disease-2019-covid-19

21. Soares-Weiser K. Statement on physical interventions to interrupt or reduce the spread of respiratory viruses. *Cochrane*, June, 2024. https://www.cochrane.org/news/statement-physical-interventions-interrupt-or-reduce-spread-respiratory-viruses-review

22. Lazzarino A. The curious case of the Danish Mask study. *British Medical Journal*;371:m4586. doi: https://doi.org/10.1136/bmj.m4586

23. Frota S, Esteve-Gibert N, Molnar M, Vigário M. Editorial: Language development behind the mask. *Front Psychol*. 2023 May 3;14:1205215. doi: 10.3389/fpsyg.2023.1205215.

24. Abaluck J, Kwong LH, Styczynski A, et al. Impact of community masking on COVID-19: A cluster-randomized trial in Bangladesh. *Science*. 2022 Jan 14;375(6577):eabi9069. doi: 10.1126/science.abi9069.

25. Frutos A. Interim estimates of 2023-2024 seasonal influenza vaccine effectiveness – United States. *Weekly*: February 29, 2024; 73(8), 168-174. https://www.cdc.gov/mmwr/volumes/73/wr/mm7308a3.htm

26. Branswell H. The vaccine dilemma: how experts weigh benefits for many against risks for a few. *STAT*, April 23, 2018. https://www.statnews.com/2018/04/23/vaccine-dilemma-weigh-benefits-risks/?matchtype=&keyword=&cid=20740002454&agid=&device=c&placement=&creative=&target=&adposition=&utm_source=google&utm_medium=cpc&utm_campaign=pmax-health-tech&utm_term=&utm_content=&hsa_acc=5862992171&hsa_cam=20740002454&hsa_grp=&hsa_ad=&hsa_src=x&hsa_tgt=&hsa_kw=&hsa_mt=&hsa_net=adwords&hsa_ver=3&gad_source=1&gclid=EAIaIQobChMI26f1p5eVhwMVgkH_AR2QhAhnEAMYASAAEgIhzfD_BwE

27. Lind ML, Dorion M, Houde AJ, et al. Evidence of leaky protection following COVID-19 vaccination and SARS-CoV-2 infection in an incarcerated population. *Nat Commun*. 2023 Aug 19;14(1):5055. doi: 10.1038/s41467-023-40750-8.

28. Martinez MA. Compounds with Therapeutic Potential against Novel Respiratory 2019 Coronavirus. *Antimicrob Agents Chemother*. 2020 Apr 21;64(5):e00399-20. doi: 10.1128/AAC.00399-20.

29. Redfield, R, U. S. Senate Committee on Homeland Security and Government Affairs "Risky Research: Oversight of U.S. taxpayer funded high-risk research" July 11, 2024. https://www.hsgac.senate.gov/hearings/risky-research-oversight-of-u-s-taxpayer-funded-high-risk-virus-research/.

30. Rancourt DG, Hickey J Linard C., "Spatiotemporal variation of excess all-cause mortality in the world (125 countries) during the Covid period 2020-2023 regarding socio economic factors and public-health and medical interventions", *Correlation Report. July 19, 2024.*

31. *Hallett DBE. Module 1: The Resilience and Preparedness of the United Kingdom. UK COVID 19 Inquiry. July, 2024* https://covid19.public-inquiry.uk/wp-content/uploads/2024/07/18095012/UK-Covid-19-Inquiry-Module-1-Full-Report.pdf.

Table 1S:

CITY/TOWN	Mask Mandates	2021 Population	Population Density	2020 Income Per Capita	• 7/4/21 - 7/17/21	7/11/21 - 7/24/21	7/18/21 - 7/31/21	7/25/21 - 8/7/21	8/1/21 - 8/14/21	8/8/21 - 8/21/21	8/15/21 - 8/28/21	8/22/21 - 9/4/21	8/29/21 - 9/11/21	9/5/21 - 9/18/21	9/12/21 - 9/25/21	9/19/21 - 10/2/21	9/26/21 - 10/9/21	10/3/21 - 10/16/21	10/10/21 - 10/23/21	10/17/21 - 10/30/21	10/24/21 - 11/6/21	10/31/21 - 11/13/21	11/7/21 - 11/20/21	11/14/21 - 11/27/21	11/21/21 - 12/4/21	11/28/21 - 12/11/21	12/5/21 - 12/18/21	12/12/21 - 12/25/21	12/19/21 - 1/1/22	12/26/21 - 1/8/22	1/2/22 - 1/15/22	1/9/22 - 1/22/22	% Fully Vaccinated Jan, 2022
Acton	0	23,846	1,200	81,081	1.8	3.3	3.9	4.2	6.6	8.4	8.1	10.8	10.2	7.8	9.9	12.9	11.1	6.3	7.2	7.8	8.1	12.3	22.3	26.2	25.6	27.7	30.1	65.9	111.4	156.5	175.5	121.6	95.8
Ashby	0	3,170	134	38,719	4.1	2.0	0.0	6.1	12.3	14.3	12.3	12.3	22.5	36.9	32.8	20.5	20.5	32.8	34.8	18.4	20.5	22.5	30.7	69.6	116.7	118.8	88.1	61.4	59.4	104.4	131.1	135.2	71.6
Ashland	0	18,560	1,505	59,335	0.4	0.4	3.6	11.2	13.4	10.2	7.3	10.2	12.3	10.5	10.9	11.2	7.6	5.8	8.3	15.2	16.7	16.0	19.6	17.0	17.4	31.2	47.5	59.1	133.1	233.1	230.6	148.7	94.9
Ayer	0	8,400	942	40,320	1.8	1.8	6.2	12.3	7.9	10.6	26.5	26.5	18.5	18.5	19.4	22.9	29.1	23.8	18.5	22.1	21.2	30.0	50.3	54.7	53.8	67.0	68.8	67.9	128.8	239.0	289.3	226.7	87.8
Boxborough	0	5,425	527	73,599	0.0	2.8	9.9	11.3	4.2	1.4	4.2	11.3	18.3	35.2	32.4	14.1	12.7	15.5	15.5	14.1	9.9	9.9	15.5	22.5	32.4	38.0	39.4	69.0	126.7	185.9	188.7	102.8	92.2
Burlington	0	25,989	2,216	59,089	3.9	5.6	8.5	9.0	10.5	13.1	15.1	15.1	12.8	11.6	11.0	12.6	12.8	12.8	12.6	14.6	15.7	16.9	28.5	31.8	37.0	48.3	58.3	80.1	146.6	246.5	249.3	158.4	91.1
Chelmsford	0	35,933	1,606	61,805	2.2	4.2	6.6	8.3	10.3	16.1	21.2	22.6	23.8	29.4	31.2	22.6	17.5	18.9	18.5	19.1	23.8	27.8	38.5	44.5	53.8	54.0	48.6	64.1	113.8	205.7	222.4	152.3	87.4
Concord	0	18,184	742	166,197	1.1	5.0	8.8	12.6	14.9	9.9	9.5	9.2	9.2	11.8	11.8	10.3	9.9	11.1	14.1	16.8	12.2	8.8	14.9	18.3	19.1	25.9	30.9	43.5	90.0	153.3	170.8	114.4	99.8
Dracut	0	32,159	1,559	39,887	1.5	1.5	4.0	11.7	24.0	25.6	23.8	29.5	26.7	26.0	28.6	22.7	25.1	30.4	26.2	24.0	27.5	37.2	58.4	67.4	80.7	105.6	103.8	92.1	135.3	272.4	287.8	188.0	75.7
Everett	0	48,557	14,157	24,363	1.3	5.0	7.2	9.9	13.5	14.6	15.6	16.0	19.9	22.8	20.3	17.5	17.1	15.7	15.2	13.7	13.8	17.8	21.3	20.2	34.9	52.1	57.7	85.0	221.6	477.7	467.4	243.5	84.4
Hopkinton	0	18,943	721	94,319	0.9	3.5	5.7	8.7	17.0	14.4	9.2	13.5	17.0	14.8	10.9	10.5	13.5	20.1	18.3	14.0	12.6	12.2	26.6	35.3	36.2	44.5	74.6	133.9	192.7	276.4	284.7	174.8	91.7
Marlborough	0	41,110	1,970	40,015	0.7	1.5	4.1	7.0	11.8	14.7	14.9	18.0	18.8	15.1	13.3	13.1	16.0	17.2	14.6	13.9	14.7	23.9	32.1	28.8	32.9	46.3	57.3	77.8	195.0	381.4	410.1	250.9	88.6
Pepperell	0	11,577	512	45,071	1.2	5.2	8.1	19.2	25.0	20.9	14.5	10.5	17.4	19.2	18.6	20.3	22.1	22.7	17.4	9.3	14.5	23.2	30.2	37.8	42.4	54.6	69.1	62.8	74.4	110.4	141.8	118.0	76.5
Reading	0	25,223	2,535	73,100	0.8	4.1	6.5	7.5	9.3	11.9	15.7	17.5	20.6	18.6	17.5	15.7	12.6	15.5	16.0	17.0	21.7	22.7	30.7	43.1	59.6	61.7	55.2	72.5	124.1	211.9	220.4	141.9	91.4
Shirley	0	7,279	459	35,497	0.8	0.8	5.0	34.3	56.1	41.1	18.4	7.5	7.5	15.9	23.5	19.3	17.6	15.1	11.7	10.1	15.9	20.1	22.6	22.6	35.2	46.1	44.4	51.1	78.8	155.0	232.1	202.7	74.3
Stoneham	0	22,877	3,800	52,421	3.5	7.1	11.5	18.3	26.9	30.5	23.7	17.6	15.1	14.4	15.1	25.0	31.8	28.6	22.8	23.7	28.2	27.3	29.8	31.4	54.5	72.2	67.7	89.5	183.8	290.7	283.3	192.5	88.1
Stow	0	7,059	408	83,990	2.0	4.9	4.9	16.8	13.8	4.9	10.8	13.8	10.8	17.7	17.7	7.9	8.9	12.8	15.8	33.5	48.3	32.5	13.8	14.8	29.6	36.5	40.4	44.4	91.7	172.5	213.0	154.8	93.3
Tewksbury	0	30,876	1,492	47,985	3.0	4.2	5.8	5.8	11.8	25.5	29.9	31.5	29.7	23.6	26.0	25.3	18.5	23.4	30.4	26.4	26.9	35.5	33.6	30.1	55.1	86.0	86.7	89.0	160.6	285.5	296.6	193.9	81.4
Townsend	0	8,983	274	40,552	0.8	0.8	3.1	8.6	17.2	18.8	18.8	14.1	16.5	18.8	19.6	26.6	34.5	32.9	24.3	18.8	16.5	29.0	54.1	48.6	47.0	65.1	70.5	71.3	82.3	121.5	146.6	110.5	74.7
Tyngsborough	0	12,421	741	49,058	0.6	1.8	4.2	7.2	11.3	22.1	30.4	25.6	24.4	38.2	42.3	33.4	25.6	20.9	23.9	31.6	34.0	46.5	51.9	47.7	72.7	93.6	93.0	93.6	118.1	203.9	236.1	170.5	76.7
Waltham	0	64,015	5,029	43,501	4.9	5.7	8.3	8.6	12.3	14.3	14.9	14.0	14.2	20.0	20.4	16.7	13.3	11.6	11.3	9.9	8.1	13.1	20.2	21.8	31.1	38.1	53.4	86.6	145.9	231.8	228.2	139.2	83.6
Watertown	0	35,149	8,809	54,414	2.8	6.3	11.5	13.0	11.7	13.6	12.5	14.5	14.7	8.6	7.8	12.1	15.8	13.4	10.2	9.9	13.4	18.4	21.6	23.6	24.4	32.9	42.2	70.1	145.1	219.7	212.8	136.6	89.2
Woburn	0	41,056	3,248	49,289	1.9	3.6	5.7	11.7	15.5	13.1	12.6	13.2	17.2	21.3	19.8	17.4	14.4	13.2	19.4	22.2	23.2	29.2	31.7	32.5	46.1	52.3	61.4	86.4	178.2	343.7	354.9	205.4	84.3
	All Public																																
Arlington	1	45,617	8,858	74,842	2.2	3.7	3.3	6.4	10.3	9.8	10.4	7.6	6.9	11.5	9.8	7.6	7.9	6.4	6.4	7.2	8.3	11.8	12.5	14.2	20.3	25.7	29.1	44.6	86.2	138.7	140.9	92.0	93.4
Bedford	1	14,155	1,036	82,483	3.3	5.7	9.1	7.1	9.1	16.2	26.2	22.4	19.1	23.8	18.6	10.5	9.1	11.9	10.5	6.7	12.9	17.1	18.6	25.7	41.9	44.3	39.1	67.2	140.0	272.0	296.8	188.6	91.2
Belmont	1	26,838	5,772	116,207	2.1	4.7	5.0	7.8	10.7	10.7	13.3	9.4	9.1	9.6	6.5	7.6	8.6	8.3	7.8	9.4	12.5	11.5	14.3	14.1	13.3	20.8	30.5	49.8	105.8	197.8	197.5	130.6	94.7
Billerica	1	41,453	1,621	46,050	2.5	4.3	5.4	8.0	12.8	16.4	19.5	27.2	32.2	27.2	21.9	17.2	13.7	22.2	26.0	23.4	30.9	34.3	36.3	41.4	67.4	91.9	78.3	71.0	125.3	235.4	252.2	171.6	82.8
Cambridge	1	117,090	18,324	74,061	3.1	7.5	10.4	10.7	11.2	12.9	15.6	19.4	20.6	17.5	17.2	13.0	8.7	7.7	11.2	11.7	10.7	13.3	17.5	18.7	28.6	41.5	57.7	87.6	130.1	235.7	278.1	190.3	86.1

Carlisle	1	5,181	340	229,125	1.5	0.0	3.0	6.0	6.0	3.0	6.0	10.6	10.6	9.1	7.6	12.1	10.6	15.1	15.1	4.5	10.6	10.6	13.6	18.1	18.1	31.8	31.8	49.9	111.9	263.1	288.9	186.0	95.9
Dunstable	1	3,341	203	78,539	4.3	4.3	2.1	2.1	12.9	27.9	30.0	21.4	25.7	23.6	10.7	15.0	23.6	12.9	10.7	23.6	30.0	34.3	36.5	38.6	42.9	55.8	51.5	66.5	90.1	135.1	145.8	103.0	77.9
Lexington	1	34,071	2,074	139,581	1.0	3.4	5.7	8.2	10.3	10.9	9.2	8.2	9.9	8.0	4.8	4.4	5.4	8.2	10.9	7.5	6.5	8.0	10.3	14.9	17.4	19.9	26.6	46.5	87.2	160.1	186.1	139.0	101.0
Lincoln	1	6,890	484	160,933	1.6	1.6	4.1	10.7	9.0	4.9	7.4	6.6	4.1	2.5	0.8	0.8	2.5	4.9	7.4	8.2	5.7	4.1	2.5	6.6	11.5	8.2	9.0	22.2	48.5	96.1	126.5	87.1	91.9
Littleton	1	10,121	613	64,359	0.7	2.2	3.7	8.8	10.2	12.4	22.0	23.4	21.2	19.8	18.3	26.4	35.9	38.1	25.6	9.5	10.2	24.2	46.1	38.1	32.2	49.8	49.8	62.2	121.5	214.5	234.3	160.3	92.1
Lowell	1	113,994	8,394	25,563	2.5	4.4	8.6	15.3	19.6	20.2	19.8	19.4	21.1	21.8	22.4	20.3	17.5	18.0	20.7	25.2	27.5	33.8	47.3	53.3	76.1	94.2	86.2	79.6	144.9	317.7	351.4	232.2	75.0
Newton	1	87,453	4,902	163,628	2.5	4.8	7.1	8.7	9.0	7.6	10.6	12.4	12.7	13.6	11.8	11.5	13.2	15.9	15.4	9.7	6.9	8.6	11.9	14.5	18.8	25.3	35.8	56.7	101.4	164.0	172.0	134.6	104.5
Somerville	1	79,815	19,373	52,596	2.8	5.3	8.6	12.3	12.6	13.0	14.3	13.6	13.6	19.0	18.1	12.5	12.7	12.0	11.5	11.4	15.6	17.4	20.3	23.4	32.2	41.0	54.0	89.4	144.6	231.6	241.2	155.4	87.4
Sudbury	1	19,059	785	120,396	2.0	2.8	3.6	6.0	8.4	10.8	13.6	13.2	8.8	11.2	8.8	4.4	8.8	13.2	14.8	15.2	10.8	10.0	13.2	14.4	23.7	36.1	40.5	48.9	90.6	176.1	204.9	137.6	93.3
Westford	1	24,446	808	72,500	3.7	7.7	12.1	11.4	6.2	10.2	21.3	25.7	20.7	15.2	13.9	14.5	17.3	21.0	21.0	18.6	17.6	19.8	35.3	40.2	47.3	51.7	48.6	65.3	122.2	211.3	230.5	152.5	92.0
	Mun Blyg																																
Framingham	2	71,265	2,846	41,182	1.5	4.2	7.3	9.4	12.3	12.1	10.4	10.5	11.6	10.4	8.4	7.0	7.7	10.1	11.6	15.4	15.1	13.4	20.0	21.5	31.0	47.5	63.6	77.2	146.7	294.2	340.4	227.0	92.3
Groton	2	11,147	340	86,514	3.1	2.4	3.1	8.6	12.2	11.0	7.9	9.8	13.4	12.8	15.9	20.2	15.9	14.1	14.7	12.8	12.2	13.4	20.8	24.4	34.8	49.5	55.0	59.3	91.0	154.0	175.4	110.6	91.1
Holliston	2	14,840	796	65,547	1.0	3.6	7.8	11.4	18.7	19.3	13.0	7.8	11.4	15.1	12.5	10.4	13.0	17.2	13.5	10.4	15.1	16.7	19.8	24.5	35.4	49.4	45.3	51.0	130.1	217.5	221.7	161.3	92.7
Hudson	2	19,790	1,718	44,478	3.1	3.7	5.1	6.1	10.5	12.5	15.6	20.3	21.7	18.3	18.3	18.3	15.6	16.6	18.7	23.1	22.4	14.6	22.7	32.6	45.1	54.3	57.0	78.3	173.0	346.3	360.9	203.2	89.7
Malden	2	65,074	12,912	32,422	1.9	5.2	7.9	10.2	15.0	16.2	12.2	12.2	13.5	15.2	18.2	18.2	14.5	11.9	12.9	11.6	12.8	17.3	21.6	22.8	33.8	44.2	52.5	69.0	152.0	316.9	323.8	184.0	88.9
Maynard	2	10,574	2,030	46,985	2.1	4.8	6.2	6.2	6.9	10.3	11.0	13.7	15.8	17.8	15.1	8.9	9.6	13.7	14.4	8.9	13.7	33.6	37.1	28.1	37.1	39.8	35.0	59.0	116.7	186.7	214.2	153.1	90.1
Medford	2	62,098	7,666	44,898	3.4	8.9	9.4	9.5	12.5	16.0	15.9	15.9	19.7	22.7	21.4	18.8	16.9	14.1	14.0	18.5	20.8	24.7	27.9	24.6	33.5	47.6	58.4	91.0	159.3	279.2	292.1	190.6	84.4
Melrose	2	29,312	6,263	60,541	2.2	4.7	7.9	10.6	14.3	19.7	22.4	20.9	18.0	15.0	15.3	15.3	14.5	14.3	13.8	15.8	23.7	25.4	26.4	27.4	38.9	56.9	64.1	87.0	170.3	275.7	255.3	165.6	89.8
Natick	2	36,426	2,437	69,429	3.2	4.4	5.9	8.7	9.5	10.5	11.9	12.5	11.9	12.9	11.5	8.9	8.3	8.9	8.1	8.1	9.9	10.1	13.1	17.3	24.8	32.3	35.3	48.4	124.5	231.4	219.3	131.9	94.4
North Reading	2	15,343	1,168	72,066	1.3	4.3	6.4	8.6	16.3	22.3	24.9	24.9	21.9	21.4	21.4	19.3	17.6	13.7	8.6	7.7	11.6	17.2	24.9	28.7	43.7	86.2	97.3	97.3	143.7	232.4	236.3	153.1	88.4
Sherborn	2	4,390	277	236,034	1.9	7.6	11.4	9.5	17.0	26.5	22.7	17.0	11.4	18.9	22.7	24.6	18.9	13.3	7.6	0.0	5.7	9.5	20.8	22.7	20.8	37.9	51.1	56.8	75.7	176.0	215.8	128.7	94.6
Wakefield	2	27,104	3,683	55,294	1.6	2.4	6.8	8.7	12.4	21.1	27.4	26.3	23.2	22.4	21.1	19.2	18.2	18.4	20.5	21.9	27.7	30.6	35.3	37.9	54.8	69.5	63.0	79.6	166.0	261.1	239.7	155.4	85.5
Wayland	2	13,724	912	177,727	0.5	4.9	8.6	16.2	18.9	16.2	12.4	7.6	8.6	9.7	10.3	13.0	11.9	9.7	13.5	10.3	12.4	22.7	30.3	27.0	22.2	32.4	35.7	58.9	120.5	181.6	201.0	144.3	100.5
Weston	2	11,666	694	430,522	2.0	7.8	9.8	9.8	17.6	16.9	15.0	15.6	15.0	16.3	11.1	7.8	11.7	14.3	7.8	5.9	6.5	9.8	9.1	14.3	31.2	28.0	31.2	72.2	111.2	171.7	184.1	122.9	93.5
Wilmington	2	23,012	1,355	53,566	2.3	3.2	5.5	6.4	10.2	18.7	28.0	30.7	23.4	19.3	21.9	18.1	13.7	19.0	20.1	16.6	21.3	24.5	35.0	40.9	59.9	82.9	78.8	79.7	144.3	252.3	251.1	151.6	84.9

• Two week rolling average of PCR positive SARS2 tests per 100,000 population